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The fragmented peri-Saharan distribution of the subgenus *Pandinurus* Fet, 1997 with the description of a new species from Chad (Scorpiones, Scorpionidae, *Pandinus*)

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Abstract

Despite their large size, the scorpions of the genus *Pandinus* Thorell, 1876 are surprisingly not sufficiently recorded in the African countries. This is particular true for the species that inhabit the Sahel zone, which seem to be very rare. The peri-Saharan pattern of distribution of the subgenus *Pandinurus* Fet, 1997 is very fragmented and this reflects the presence of endemic species such as the recent discovered *Pandinus nistriae* Rossi, 2014 in the northern Djibouti, where this genus was never recorded. In the present study, an additional new species, *Pandinus* (*Pandinurus*) *vachoni*, is described from Chad to represent the most western species of the subgenus *Pandinurus* ever recorded.

Keywords: Scorpions, Scorpionidae, *Pandinus*, *Pandinurus*, new species, Chad.

Introduction

Pandinus Thorell, 1876 is a widespread genus with presently 31 species distributed from Senegal to Yemen (Rossi, 2014). It includes five subgenera (Vachon, 1974; Fet, 1997) and almost half of the species are belonging to the subgenus *Pandinurus* (Rossi, 2014). In the recent years, two well known species such as *Pandinus dictator* (Pocock, 1888) and *Pandinus gambiensis* Pocock, 1899, both included in the CITES list, appendix II (Lourenço & Cloudsley-Thompson, 1996) have been reported from countries where they were not known previously (Prendini, 2004; Rossi, 2014). Even more remarkable, the discoveries of new *Pandinus* species in countries where scorpions of this genus were never regarded as in the cases of *Pandinus ugandaensis* Kovařík, 2011 from Uganda, *Pandinus ulderigoi* Rossi, 2014 from Central African Republic, and *Pandinus nistriae* Rossi, 2014 from Djibouti. Several species of the subgenus *Pandinurus* have a

peri-Saharan distribution, starting in East-Africa with *P. nistriae* in the northern Djibouti, passing through Eritrea and northern Ethiopia with *P. magrettii* Borelli, 1901 and arriving into the Sahel zone in Sudan with *P. sudanicus* Hirst, 1911. A new species is now reported from Chad and it represents the most western species of the subgenus *Pandinurus*, although the exact locality of collecting remains, for the moment, unknown. However, a very important indication about its distribution could come from the presence of traces of the substratum. In fact, the specimen has many incrustations on the cuticula which confirm, for size, colour and aspect, a provenance from the Sahel that occupies the central zone of Chad (Bellani, 2008). Also for the recent described species, *P. ulderigoii* from Central African Republic, the exact type locality was unknown. However, new examined material allowed discovering the correct type locality (Rossi, in preparation). Also in that case, the analysis of the incrustations on the cuticula addressed to a possible habitat represented by tropical forest that was subsequently confirmed by the new examined specimens with precise and known localities.

Material and Methods

Descriptions and measurements (in mm) mostly follow respectively Hjelle (1990) and Sissom et al. (1990). The new species of the subgenus *Pandinurus* is compared with the other three species of the subgenus that show a peri-Saharan distribution: *Pandinus nistriae* Rossi, 2014 from Djibouti, *Pandinus magrettii* Borelli, 1901 from Eritrea and Ethiopia, and *Pandinus sudanicus* Hirst, 1911 from Sudan. An updated identification key for the subgenus *Pandinurus* is proposed.

Abbreviations used:

L = length; W = width; H = height.

BMNH = Natural History Museum, London, United Kingdom

MCVR = Museo Civico di Storia Naturale di Verona, Italy

MRAC = Musée Royal de l'Afrique Centrale, Tervuren, Belgium

MSNM = Museo Civico di Storia Naturale di Milano, Italy

MZUF = Museo di Storia naturale dell'Università degli Studi di Firenze, Sezione di Zoologia "La Specola", Italy

Taxonomy

Family Scorpionidae Latreille, 1802

Genus *Pandinus* Thorell, 1876

Subgenus *Pandinurus* Fet, 1997

Pandinus (*Pandinurus*) *magrettii* Borelli, 1901 (For the references see Rossi: 2014)

Type locality and type depository: Eritrea, Keren; MSNM.

Distribution: Eritrea, Ethiopia.

Material examined: 4♀♀, 2 imm., Eritrea, Adi Ugrì, 16-30.VI.1901, leg. A. Andreini, (MZUF: 1110); 1♀, Ethiopia, Mai Canetà, 1936, leg. Cartolari, (MCVR: 200).

Pandinus (*Pandinurus*) *nistriae* Rossi, 2014

Type locality and type depository: Djibouti, Medeho; MZUF.

Distribution: Djibouti.

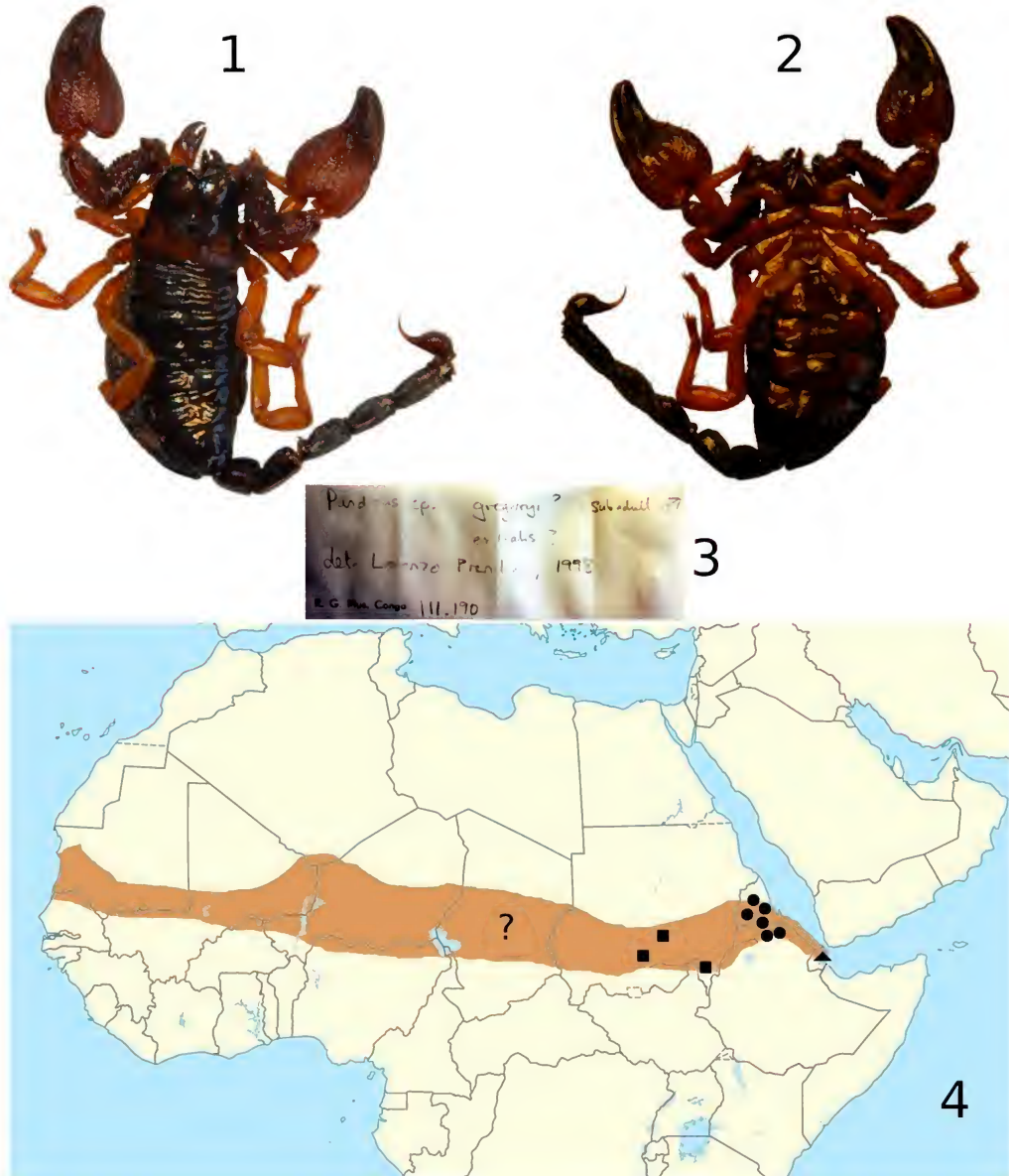
Material examined: 1♂ holotype, Djibouti, Medeho, Obock district, 11°58'15"N, 43°01'30"E, 25.II.2013, leg. P. Agnelli, A. Nistri & A. Ugolini, (MZUF: 4133).

Pandinus (Pandinurus) sudanicus Hirst, 1911
 Pandinus exitialis sudanicus Hirst, 1911: 219.
 Pandinus magrettii: Birula, 1928: 85 (in part).
 Pandinus (Pandinurus) magrettii (in part): Fet, 2000: 471–472; Kovařík, 2009: 54.
 Pandinus sudanicus: Kovařík, 2012: 1, 3-4, 6, 12, 17, 19-20; Rossi, 2014: 11-12, 16, 21.
 Type locality and type depository: Sudan, Gebel Mountains, S of Obeid; BMNH.
 Distribution: Sudan.
 Material examined: 1♀, Sudan, Ingessana hills, S. W. of Roseires, 11°27'N, 33°59'E, XII.1968, leg. J. L. Cloudsley-Thompson, (MRAC: 134.601).

Pandinus (Pandinurus) vachoni sp. n. (Figs. 1, 2)
 Pandinus sp. Prendini et al. 2003: 234.
 Type locality and type depository: Chad; MRAC.
 Type material: 1 subadult ♂ holotype, Chad, [without exact locality but most probably from the Sahel zone in the central area of Chad], leg. Bruining, (MRAC: 111.190).
 Diagnosis: total length 72.73 mm (Table 1). Chela of pedipalp with 2 internal and 9-10 ventral trichobothria (Fig. 6). Base colour uniformly blackish-brown, legs yellowish-orange (Fig. 1). Pectinal teeth number 22-24 in male (Fig. 2). Dorsal surface of manus with many tubercles but not conical or pointed (Fig. 1). Dorsal carinae on third and fourth metasomal segments without marked denticles (Figs. 1, 2). Ventral side of manus with two longitudinal carinae covered by several small granules. Tarsomere II with 3 spines on the inclined antero-ventral surface. Spination formula of tarsomere II = 6/4: 6/4-5: 6-7/4: 7/4. Tarsomere I of legs IV has a distal prosuperior seta (Fig. 12).
 Etymology: The species is named in honour of the late Prof. Max Vachon (1908-1991) for his important contribution to the taxonomy of the genus Pandinus.

Table 1. Morphometric values (in mm) of the subadult ♂ holotype of Pandinus (Pandinurus) vachoni sp. n.

Pandinus (Pandinurus) vachoni ♂, MRAC 111.190	
Carapace L/W	11.12/12.66
Mesosoma L	24.03
Metasomal segment I L/W/H	5.01/4.86/3.58
Metasomal segment II L/W/H	5.43/4.39/3.21
Metasomal segment III L/W/H	5.71/3.81/3.29
Metasomal segment IV L/W/H	5.84/3.39/2.98
Metasomal segment V L/W/H	8.12/3.30/3.22
Telson L/W/H	7.47/2.96/2.83
Pedipalp femur L/W	8.19/3.97
Pedipalp patella L/W	8.59/4.43
Pedipalp chela L/W	16.05/9.62
Pedipalp movable finger L	10.33
Pectinal teeth	24-22
Total L	72.73



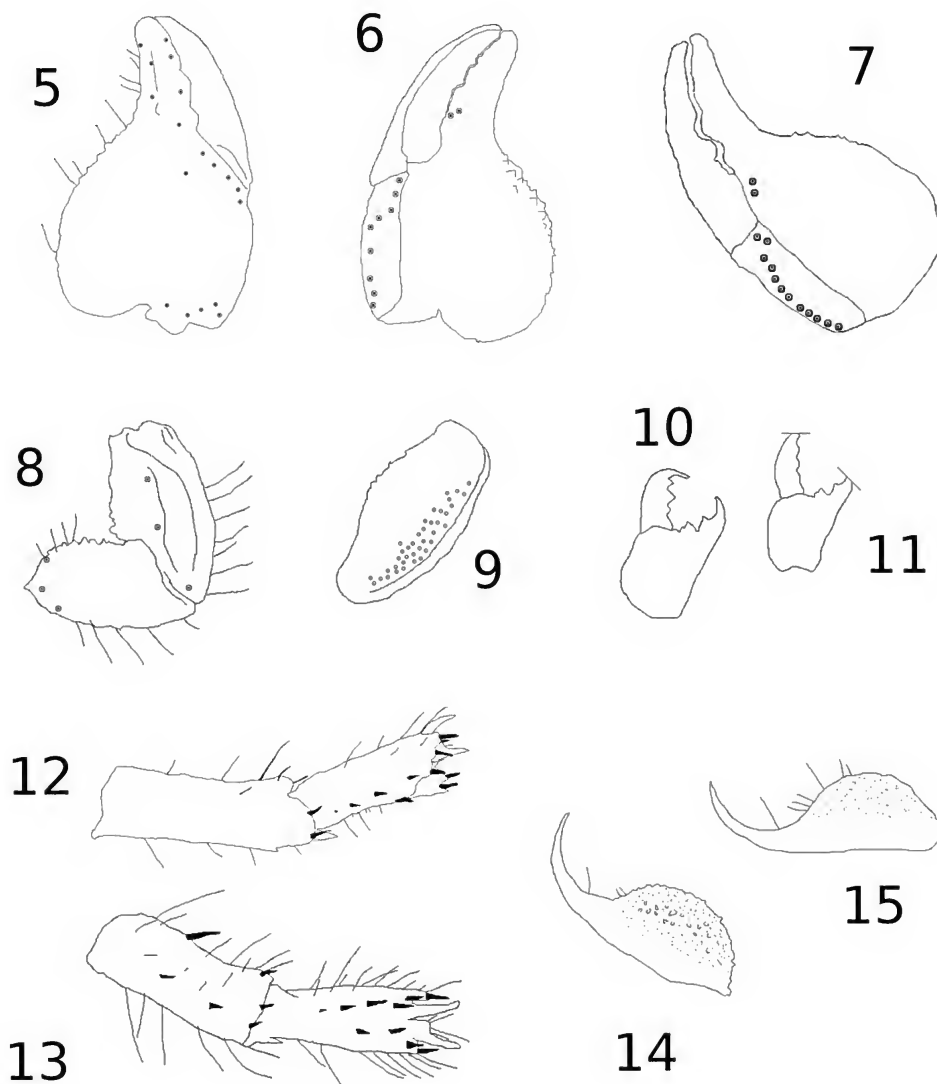
Figs. 1-2. *Pandinus (Pandinurus) vachoni* sp. n. male holotype. 1. dorsal view. 2. ventral view. Fig. 3. Original label in the vial.
 Fig. 4. Map of distribution of the species of the subgenus *Pandinurus* in the Sahel: triangle = *P. nistriae*; circle = *P. magrettii*; square = *P. sudanicus*; question mark = *P. vachoni* sp. n.; orange-brown area = approximate zone of the Sahel.

Description

Colouration: carapace dark brown; tergites uniformly blackish-brown; sternites dark brown; metasomal segments uniformly blackish-brown; pleural membrane dark grey to blackish; pedipalps brown but fingers blackish-brown; telson dark brown; pectines and genital operculum dark yellow; coxapofisis brown; legs and sternum yellowish-orange (Figs. 1-2).

Prosoma: carapace without carinae; two depressions in each posterior sides; the surface is smooth and scarcely granulated. Its posterior width is longer than its length. The anterior margin has a concavity. Median eyes orange-brown and separated by less than two ocular

diameters; three pairs of small lateral eyes black. The distance from the anterior border of the carapace to the median eyes is about 55% of the carapace length.



Figs. 5-9. Trichobothrial pattern. 5-6, 8-9. *P. vachoni* sp. n. male holotype. 5-6. Right pedipalp chela. 5. dorsal view. 6. ventral view. 8. Right femur and patella, dorsal view. 9. Right patella, ventral view. 7. Right pedipalp chela of *P. nistriae* Rossi, 2014 male holotype, ventral view. Figs. 10-11. Chelicera, dorsal view. 10. *P. magrettii* Borelli, 1901. 11. *P. vachoni* sp. n. male holotype. Figs. 12-13. Tarsomeres I and II of legs IV. 12. *P. vachoni* sp. n. male holotype 13. *P. magrettii*. Figs. 14-15. Telson. 14. *P. magrettii*. 15. *P. vachoni* sp. n. male holotype.

Mesosoma: tergites smooth without carinae. Sternites smooth; sternites III to VI with two furrows; sternite VII with two vestigial furrows. Spiracles strongly elongated.

Metasoma: elongated with all segments longer than wide; length/width ratio of I metasomal segment is 1.03 and that of V metasomal segment is 2.46; segment I with 8 complete and 2 incomplete lateral carinae; segments II to IV with 8 carinae; segment V

shows 7 carinae, which have spinoid tubercles. Segments I to IV are ventrally smooth while segment V is strongly granulated.

Telson: vesicle is relatively small and elongated with few hairs; it is finely granulated; aculeus curved and about as long as vesicle; subaculear tubercle not noticeable (Fig. 15).

Chelicerae: ventral aspect of both fingers and manus covered with long yellow dense setae. Movable finger with distal external and distal internal teeth not opposable to moderately opposable. The teeth of the movable finger are low and not pointed (Fig. 11).

Pedipalps: all segments are scarcely hirsute. Trochanter strongly granulated. Femur with four marked tuberculated carinae; many granules are present on anterior and dorsal side of femur; the externoventral carina is scarcely marked and distally smooth. The patella shows five carinae mainly smooth; the external surface of patella is smooth while the anterior surface is finely granulated. The chela is lobate (Fig. 5), with a L/W ratio of 1.67, and has two smooth ventral carinae. The entire dorsal surface of the chela is densely tuberculated: the granules are not pointed; their summits are sometimes confluent; the granules are arranged in three dorsal carinae which are confused with the other granules (Fig. 1). The movable finger does not show a big distal tooth. Both movable and fixed fingers have 5 or 6 subrows on the dentate margin. The internal surface of the chela has many granules and two carinae. Chela of pedipalp with 2 internal and 9-10 ventral trichobothria (Fig. 6). The trichobothrial pattern is Type C (Vachon, 1974) (Figs. 8, 9).

Legs: scarcely hirsute. Prolateral pedal spurs present. Tarsomere II of all legs bears three spines on the inclined anteroventral surface. The spination formula of tarsomere II = 6/4: 6/4-5: 6-7/4: 7/4. Tarsomere I of legs I-III bears a distal prosuperior spine. Tarsomere I of legs IV has a distal prosuperior seta (Fig. 12).

Pectines, genital operculum and sternum: pectinal teeth count is 22-24 in the male holotype; female unknown. Genital operculum wide and lobate, divided into two parts; it is strongly wider than long. Sternum subpentagonal, longer than wide (Fig. 2).

Distribution: Chad.

Relationships and comments: *Pandinus vachoni* sp. n. can be readily distinguished from the other three species of the subgenus *Pandinurus* with a peri-Saharan distribution by a combination of characters. *Pandinus nistriae* Rossi, 2014 has a very different spination formula of tarsomere II = 6-7/5: 7/5: 7/5-6: 8/6 and the pedipalp chela with 11-12 ventral trichobothria (Fig. 7). *Pandinus sudanicus* Hirst, 1911 has tarsomere II with only 2 spines on the inclined anteroventral surface and the pedipalp chela with 11-12 ventral trichobothria. *Pandinus magrettii* Borelli, 1901 has a reduced number of pectinal teeth (18-22), the pedipalp chela with 10-11 ventral trichobothria, the chelicera movable finger with longer and more pointed teeth (Fig. 10), the tarsomere I of legs IV which bears a distal prosuperior spine (Fig. 13) and the vesicle strongly granulated (Fig. 14).

Biogeographical and ecological notes

Ecological data on *Pandinus* species are quite rare. Lourenço & Cloudsley-Thompson (1999) discussed the populations of *Pandinus imperator* (C.L. Koch, 1841) in the Ivory Coast. Subsequently Prendini (2004) gave some additional notes on the three species in the CITES list. Kovařík (2011, 2012, and 2013) showed new data for several species from East-Africa. However, little is known about the four *Pandinurus* species that inhabit the Sahel. The most common species seems to be *P. magrettii* which is present in Eritrea and northern Ethiopia. A specimen from Mai Canetâ, deposited in MCVR, represents a new locality in northern Ethiopia (Fig. 4). It was collected in 1936, most probably during the Italian expedition to Abyssinia that did stop-over in the same locality (Genta, 1937). A species with a relatively wide distribution is also *P. sudanicus* which is present in several localities in Sudan. Kovařík (2012) cited repeatedly that it is present in

South Sudan but actually no specimens are known from this country. It is recorded in the states of Northern Kordofan and Southern Kordofan. The specimen deposited in MRAC came from Ingessana and was collected personally by Prof. J.L. Cloudsley-Thompson. It represents a new record of this species from the state of Blue Nile, in Sudan (Fig. 4). Hirst (1911) cited a single male of *P. exitialis* (Pocock, 1888), deposited in BMNH, from Blue Nile (now Al Jazirah) but most probably it belongs to *P. sudanicus*. A very rare species is *P. nistriae*; it is recorded only in the northern Djibouti, from the locality of Medeho in the Obock district (Fig. 4). Finally, *P. vachoni* sp. n. comes from Chad, most probably from the central zone represented by the Sahel, in a zone of transition between the Sahara desert and the savannah (Bellani, 2008). The scorpion fauna of Chad was recently studied by Lourenço et al. (2012) with the descriptions of nine new species, showing that the scorpions in this country were still insufficiently studied. In fact, a very wide area between Chad and Libya is very little investigated concerning scorpion-fauna (Rossi et al., 2013). However, Lourenço et al. (2012) did not record any *Pandinus* species in Chad. Prendini et al. (2003) cited a single specimen from Chad which is the same sample examined in this study. It was personally studied by Prendini in 1998, as proved by a label in its vial (Fig. 3). He tentatively assigned this specimen to “*P. exitialis/P. gregoryi*” with a question mark. This decision was anyway incorrect since both *P. exitialis* and *P. gregoryi* (Pocock, 1896) have the tarsomere II with 2 spines on the inclined anteroventral surface, while *P. vachoni* sp. n. has 3 spines.

Identification key for the species of the subgenus *Pandinurus* Fet, 1997:

1. Tarsomere II with 3 spines on the inclined anteroventral surface 2
- Tarsomere II with 2 spines on the inclined anteroventral surface 8
2. Spination formula of tarsomere II of 4th leg = 8-9/6. Chela of pedipalp bears 11-14 ventral trichobothria 3
- Spination formula of tarsomere II of 4th leg = 6-8/4-5. Chela of pedipalp bears 9-12 ventral trichobothria 4
3. 12-14 ventral trichobothria; typical spination formula of tarsomere II = 7-8/5-6: 8/6: 8/6: 8-9/6-7; in male L/H ratio of IV metasomal segment 2.63; dorsal surface of chela almost smooth *P. meidensis* Karsch, 1879
- 11-12 ventral trichobothria; spination formula of tarsomere II = 6-7/5: 7/5: 7/5-6: 8/6; in male L/H ratio of IV metasomal segment 2.37; dorsal surface of chela densely granulated *P. nistriae* Rossi, 2014
4. Dorsal surface of manus with evenly sized conspicuous granules. Chela densely hirsute. Chela of pedipalp length to width ratio in both sexes between 2 and 2.2 5
- Dorsal surface of manus more or less tuberculate, without evenly sized granules. Chela with only a few hairs, more lobate and wider. Chela of pedipalp length to width ratio in both sexes between 1.6 and 1.9 6
5. Legs of adults yellow. Tarsomere I of legs I- IV with distal prosuperior spine. Females with 20-23 pectinal teeth *P. somalilandus* Kovařík, 2012
- Legs of adults reddish brown. Tarsomere I of legs I-III with spine, but on leg IV with distal prosuperior seta. Female with 18 pectinal teeth *P. awashensis* Kovařík, 2012
6. Distribution: Asia (Yemen) *P. arabicus* (Kraepelin, 1894)
- Distribution: Africa (Eritrea, Ethiopia, Chad) 7
7. Pectinal teeth number 18-22; 10-11 ventral trichobothria; tarsomere I of legs IV bears a distal prosuperior spine *P. magrettii* Borelli, 1901

- . Pectinal teeth number 22-24; 9-10 ventral trichobothria; tarsomere I of legs IV bears a distal prosuperior seta *P. vachoni* sp. n.
8. Chela of pedipalp bears 10-14 ventral trichobothria. Male has more pronounced tooth on movable finger of pedipalp 9
- . Chela of pedipalp bears 6-11 ventral trichobothria. Movable finger of pedipalp without noticeable sexual dimorphism 11
9. Dorsal surface of manus with evenly sized conspicuous granules. Chela densely hirsute *P. exitialis* (Pocock, 1888)
- . Dorsal surface of manus more or less tuberculate, often with longitudinal carinae but without conical, evenly sized granules. Chela hirsute, but not densely 10
10. Legs reddish brown. Distribution: Kenya *P. gregoryi* (Pocock, 1896)
- . Legs yellow to yellowish, always lighter-coloured than body. Distribution: Sudan *P. sudanicus* Hirst, 1911
11. Legs yellow to yellowish, always lighter-coloured than body *P. pallidus* (Kraepelin, 1894)
- . Legs brownish and coloured as body 12
12. Males with chela, femur and patella of pedipalp narrower and longer than in females. Distribution: Africa 13
- . Length of segments of pedipalp without noticeable sexual dimorphism. Distribution: Asia (Yemen) *P. percivali* Pocock, 1902
13. Dorsal surface of chela reddish black and entirely granulated. Spination formula of tarsomere II of 4th leg = 4/3. First metasomal segment is wider than long in males. Chela of pedipalp length to width ratio in males less than 2.2 *P. lowei* Kovařík, 2012
- . Dorsal surface of chela red and smooth, with granules in anterior part only. Spination formula of tarsomere II of 4th leg = 5/3. First metasomal segment longer than wide in males. Chela of pedipalp length to width ratio in males greater than 2.5 *P. viatoris* (Pocock, 1890)

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